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NASA TECH BRIEF

Marshall Space Flight Center

Superior Cryogenic Insulation Developed

A new multilayer insulation composite consisting of alternate spunbond nylon layers and doubly aluminized mylar layers has been developed for use primarily in cryogenic thermal protection systems.

The spunbond nylon is constructed by placing nylon fibers in a high-temperature air stream and allowing the fibers to be blown against a screen. The fibers are fused together due to the high temperature air stream which is at the approximate melt temperature of the fibers. This fabrication technique creates a random weave geometry and weave spacing for the material. Due to this random weave pattern, the strength properties are uniform in all directions and permit greater ease in handling and fabrication. For these reasons, the composite is considered to be an improvement over other multilayer insulations.

Data generated during the test program conducted in fabrication of the multilayer insulation are presented in 3 separate reports and include a brief description of materials tested, method of specimen preparation, test procedures, and error analyses. This information should be useful to design engineers in developing multilayer insulation thermal control systems. The contents are comprehensive with regard to the variety of insulation composites, the parameters that can be varied, and the range of the parameters.

Two cylindrical calorimeters were designed and fabricated for use in obtaining temperature-dependent and layer-density dependent thermal conductivity data for multilayer insulation composites. The electrical cylindrical calorimeter consists of a phenolic glass fiber tube with 6-mil (0.15 mm) copper magnet wire wound continuously around the tube to form three individual heaters. There are no spacings between either the adjacent windings or the heaters. The result is that uniform, continuous windings completely cover the base cylinder.

The center heater serves as the test heater and is flanked on either side by an end heater. Separate power control is provided for each heater in order to provide for a uniform temperature distribution along the tube. The center test heater is automated and is designed to maintain a constant temperature at the center of a calorimeter. The end heaters are maintained at a slightly higher temperature than the test heater to reduce longitudinal heat loss. The main improvements in the instrumentation system over prior systems are that the platinum resistance thermometer is more sensitive than the thermocouple it replaces, the device has seven temperature-measurement locations in lieu of the five used previously, and all absolute thermocouples are referenced to a ConOhmic thermocouple reference junction oven rather than to LN_2 as in the past. The calorimeters are an improvement over those used previously in economy, accuracy, efficiency, and ease of data acquisition.

Notes:

1. Information concerning this innovation may be of interest to the manufacturers, designers, and users of cryogenic vacuum equipment.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Code A & TS-TU
   Huntsville, Alabama 35812
   Reference: B72-10187

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel, NASA
Marshall Space Flight Center
Code A&TS-PAT
Huntsville, Alabama 35812

Source: D. V. Hale, M. J. O'Neill, and A. J. McDanal of
Lockheed Missile and Space Co.
under contract to
Marshall Space Flight Center
(MFS-21560)

Category 04